

# Experience Report about the Inclusion of People with Disabilities in the Process of Testing an Accessible System for Learning Management

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**Abstract**—This article discusses the inclusion of people with disabilities in the process of testing an accessible system solution for distance education. The accessible system, team profile, methodologies and techniques covered in the testing process are presented. The testing process shown in this paper was designed from the experience with user. The testing process emerged from lessons learned from past experiences and the end user is present at all stages of the tests. Also, lessons learned are reported and how it was possible the maturing of the team and the methods resulting in a simple, productive and effective process.

**Keywords**—Experience report, accessible systems, software testing, testing process, systems, e-learning.

## I. INTRODUCTION

THE number of people with disabilities around the world is something that can not be disregarded, worldwide there are millions of people who have special needs. Research indicates that one in five people has a disability that hinders their way of living. A study by the World Health Organization - WHO, the United Nations organization dedicated to health issues, found in 2011 that more than 1 billion people in the world have some kind of disability [7]. According to the number of Decree 3298 of December 20, 1999, impairment is any loss or abnormality of structure or psychological function, physiological or anatomical who manages incapacity for work within the standard considered normal for humans. [2].

The decree 6.949, international convention on the rights of persons with disabilities (PwD), ensure the disabled access in equal opportunity of others to information and communication, including the systems and information and communication technologies, as well as other facilities and services open the public or for public use, both in urban as in web accessibility [3]. The Web Accessibility Initiative (WAI) endorses "that web designers and developers must understand the importance of accessibility and how an affordable web increases the power of people with special needs and society as a whole" [5].

This article aims at reporting the experience of a Research and Development Laboratory - RDL on testing an accessible system for learning management. The RDL aims to research and develop solutions for distance education that increase employment opportunities for people with disabilities. The product to be analyzed in this report is an online system that has added an Android app, bringing greater mobility for its

users. It has several courses and numerous tools that facilitate student learning and make learning accessible.

All the solutions developed are tested by a group of people with disabilities that add quality and accessibility to products. The team consists of researchers, systems analysts, software testing analysts, developers, accessibility specialists, translators and sign language interpreters, people with disabilities who perform all software testing, and other professionals who share the same goal: changing social and economic reality through an accessible education for all.

It will be initially presented in this article a description of that system and the mobile application associated with it. In the Section III, the test team is detailed and after the tools used during the testing process in this report is approached. Also, they are some test methods and adaptations that have proven necessary for efficiency and process productivity. Ultimately, it will be held the lessons learned and directives mentioned by the testers. These lessons and guidelines can assist other initiatives in the accessible system testing.

## II. ACCESSIBLE SYSTEM FOR LEARNING MANAGEMENT

Companies are audited in order to fulfill the quota law. The difficulty mentioned by these companies is to find qualified people with disabilities for the positions offered. Seeking to mitigate this problem, it is funding the research and development of an accessible system for learning management. This is a web solution integrated to a mobile app for Android, based on the methodology mobile learning (m-learning). Through this platform and mobile application, the student with a disability has access to courses covering topics of technology and entrepreneurship.

The accessible system for learning management has accessibility features for people with physical disabilities (motor), hearing and low vision. The solution offers different types of learning objects, including textual and graphical content such as images, videos, animations, tables, graphs, charts and objects that allow interactivity with the user, providing different ways of learning. All these objects aim to disseminate knowledge and contribute to the social inclusion of these people.

The platform's content: the textual content and glossary with over 400 is available in videos translated into sign language. Also the interfaces were developed respecting ergonomic standards, voice commands, shortcuts for quick access, font setting and high contrast. There is also a forum to clarify doubts

and workshops, which are encoding activities of courses on software development. Integrated to the platform is a mobile application for the Android platform. This mobile application enables configuring the provisions of interface objects, notification forms of configuration and download of videos and learning objects.

In addition to the appropriate content according to the disability, the student has access to quality content developed by pedagogical coordinators, exercises and assessments with supporting images, notes and review of issues after the response, video lessons and calendar. Learning objects can be stored on mobile devices, enabling the student can schedule a time to study and study in places where it does not have access to the Internet at any time. These systems also offer forums, chat, internal mail, enabling students to exchange experiences with each other, discuss about the contents of the lessons and have facilitated communication with the tutor of the course. The goal of the accessible system for learning management is that persons with disabilities have the same learning opportunities as people without disabilities.

### III. TEST TEAM

The team of testers consists of 50 testers, 32 deaf, 16 physically disabled people and 2 with low vision. Also 2 test analysts and 2 sign language interpreters are part of the team. The team members include people of different ages, academic levels and social classes. For project improvement, it is of utmost importance the fact that the team members are from different areas of study and have a diverse school history. This diversity aims to make the system accessible to learning management can be a support for the education of persons with disabilities in various social levels.

#### A. Profile and Role of Testers

The testers have between 25 and 50 years of age and have different deficiencies. They have access to a very diverse academic background: people who had finished just the elementary school to post-graduate students. There are also people from different social classes and different disability level.

The testers are divided in teams as follows:

- Class A: This class consists of 13 deaf testers who work 10 hours a week.
- Class B: This class consists of 12 deaf testers who work 10 hours a week.
- Class C: Composed of 8 deaf testers and 3 physical testers working 20 hours a week. This class is a different team. They were selected from each other because they have greater knowledge of the software development area. This class is responsible for testing more complex features.
- Class D: This class consists of 10 deaf testers who work 10 hours a week.

#### B. Profile and Role of Analysts

Tests analysts are post graduate students in software engineering. They are responsible for accompaniments of PwD, preparation of the testing environment, and application of the methodologies used.

#### C. Profile and Role of Sign Language Interpreters

The sign language interpreters are technical professionals. They act assisting the communication between the analysts and deaf testers.

### IV. COMMONLY USED TOOLS

#### A. Testlink

"TestLink is a free and Open Source tool to test case management used in Web platform. This tool can be used to record the system requirements and creating your test cases" [4]. This tool helps you create test cases, besides monitoring the execution and test reports. This tool is integrated with Mantis Bug Tracker, making it possible for part of the analysis and development team follow the progress of the of errors, failures and improvements reports indicated by testers.

#### B. Mantis Bug Tracker

Mantis "is a free, open source tool that allows the defect management. With the mantis it can manage the defects of several projects at the same time" [4]. Testers use the Mantis to reporting errors, failures and improvements indicating the details of the environment used for testing through custom fields suitable for project reality. By integrating TestLink and Mantis Bug Tracker it was possible to create a complete environment for distribution, execution of test cases and monitoring and management of reports.

### V. PROCESS AND METHODOLOGIES APPLIED TO TEST AN ACCESSIBLE SYSTEM FOR LEARNING MANAGEMENT

There is a continuous process of training of PwD testers, starting at the time that a new PwD is integrated into the team. Formations are carried out with the topics of software testing, heuristics of Nielsen, and accessibility guidelines of the Web Content Accessibility Guidelines - WCAG. These trainings aim to make the testers increasingly discerning in the testing process and identify problems related to accessibility during testing.

The testing process takes place from the low-fidelity prototyping. During the prototyping it has used the participatory design technique where the testers pointed out the fundamental requirements of the system. The goal is for PwD are present since the construction of software to testing and acceptance. This strategy aims to validate as regards the quality of accessibility a priority for the accessible system for learning management

The process consists of a set of test methodologies combined with the agile methodology SCRUM, which stands out from other agile methods for presenting a greater emphasis on project management. The SCRUM demonstrates the high ability to be flexible to changing without exponential cost increases, including monitoring activities, feedback, short daily meetings with the whole team and divides the development process at intervals of time named Sprint [1].

The testing process presented here adopted Sprint lasting 15 days, the same duration of the development team's Sprint. During the period of Sprint, the test team is divided between

the new features test and the creation and validation of prototypes. At the end of each Sprint, the development team launches a trial version so that functional, configuration and accessibility tests are applied. The functional tests are groups of tests that analyze and validate that what was specified in the requirements gathering was implemented. The configuration test verifies that the software is able to run on different versions or environment settings [8]. The development team releases a web version for learning management system to be tested in different browsers. It's also launched a test version of the mobile application, which is tested on Android devices from different settings, hardware, and operating system versions. The accessibility test is done through observations made by testers empirically and according to the training they were given.

As soon as the software development team releases a test version, the test analysts analyze the objects released for testing in the release notes and create test cases in the TestLink tool. According to the amount of released objects, test cases are divided among the testers classes. The testers were oriented so that during the process of execution of the cases to check every feature and software configuration, reporting any fault, error or improvement identified during the investigation, always with attention to the accessibility and usability issues with a view to making the system increasingly accessible based on user experience. These reports are made through text with step-by-step error found and screenshots that are attached to the Mantis tool, facilitating the reproduction of the error during the process of fixing errors. During the reporting, test analysts are already analyzing what was written to reduce the volume of repeated reports. Once the test team is always open to dialogue with the development team, many doubts are clarified avoiding unnecessary overload of information.

Once every two months it generated a software release. At this stage is applied the acceptance test. It has aimed to verify that the solution meets the business rules and their requirements, as they relate to functionality, usability and accessibility. The PwDs team act as end users and the process is conducted by the team of analysts, with the help of sign language interpreters for use with deaf members of the test team. For the purposes of this test it is to request the user to perform a set of routines that cover the main system features. The testing process follows the following workflow:

- 1) **Prototype validation:** They are designed through participatory design technique prototype screens and functions. During this process it is observed ergonomic factors and requirements specification [9].
- 2) **Software Development:** After validation prototypes are passed to the development team to implement the prototype screens and features.
- 3) **Functional testing, configuration and accessibility:** These methodologies are applied in an integrated manner where while the testers verify that a feature meets the requirements [8], also checks the behavior of the same in other environments, always analyzing issues related to accessibility. The accessibility testing does not require checklist with accessibility guidelines, because the testers are also end users and has empirically these

guidelines.

- 4) **Acceptance:** This test is used to test interaction methodology, to ascertain the adequacy of users to tasks and serving their needs. It is also observed in this test.

While performing all the steps in the test cases processes, videos are recorded to analyze the reaction and possible problems that occur during the interaction with the system. They are also applied forms of satisfaction survey to measure the degree of user satisfaction with the system.

## VI. CONCLUSION AND LESSONS LEARNED

During the maturing process of the development of tests, some methodologies were adopted. The results showed that some techniques were not efficient for the appropriate test model. One example was the use of spreadsheets used as the only means of delegating test cases and report problems and found improvements. This made it difficult to use communication between teams and made the error management process a laborious task. The spreadsheet editor was being a useful tool, but we could not support the large number of information to administer, frequent use of filters and successive updates of the data.

The spreadsheets were employed with Smoke Test methodology. The Smoke Test is a process in which a software product is daily launched and subjected to a series of tests to analyze and validate its basic functionality. This test is simple and can be performed daily from the earliest stages of the product implementation process, enabling the detection of defects at an early stage of the development process and software maintenance [6]. The problem was that this model was a simple and quick test, for this reason many imperceptible problems were not identified and the quality and effectiveness of the tests were compromised. Crucial issues in the evolution of the system were not reported because the testers had an overview of the system and they did not thoroughly investigate the functionality and the various possibilities for system behavior.

The problems of methodology and the process resulted in analysis, research and application of test methods which could bring higher productivity and effectiveness. This took the test team to adopt dedicated software for managing the tests. As they Testlink and Mantis Bug Tracker for management of errors, failures and improvements found by testers.

The new process (described in Section VI) brought more agility and quality of reports by the team. It was possible to realize how important it is end users being part of the whole testing process in a professional manner, acting as testers and validators. In addition to check functional problems, the members of the testers team report improvements, according to their disability systems, allowing the construction of an accessible system, tested and validated by the beneficiaries themselves.

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